Patent Claims

1.   A delivery peptide comprising an amino acid sequence of formula I:

(I) $(K)_n A_1 B_1 C_1 (K)_m A_2 B_2 C_2 (K)_l A_3 B_3 C_3 (K)_o$,

5   wherein

K is lysine (K),

B_1, B_2, B_3 is arginine (R), glutamine (Q) or histidine (H),

A_1, A_2, A_3, C_1, C_2, C_3 is arginine (R), histidine (H) or is missing,

n, m, l, o is an integer from 0 to 5, and

10   the total number of amino acid residues is not more than 10.

2.   The peptide of claim 1 comprising an amino acid sequence selected from the group consisting of:

KKRKKQKKRK (SEQ ID NO: 1), RRKKKQKKK (SEQ ID NO: 2),

KKQKKRRK (SEQ ID NO: 3), KKQKKRRKK (SEQ ID NO: 4),

15   KKKQKRKK (SEQ ID NO: 5), RQKKQKKKR (SEQ ID NO: 6),

RKQKKKRKKK (SEQ ID NO: 7), KRKQKQKKK (SEQ ID NO: 8),

KKRKQKKQK (SEQ ID NO: 9), KKKRKKQK (SEQ ID NO: 10),

RKKKKQKKK (SEQ ID NO: 11), KKRKKQKK (SEQ ID NO: 12),

QKKRRKKKQK (SEQ ID NO: 13), KKRKQKKRK (SEQ ID NO: 14),

20   KKRKQKKQKR (SEQ ID NO: 15), KRKQKQKKKK (SEQ ID NO: 16),

KKRKRKQKK (SEQ ID NO: 17), KQKRKKKQK (SEQ ID NO: 18),

KQKKRQKKKR (SEQ ID NO: 19), KKKRKQKQKK (SEQ ID NO: 20),

RKKKQKKQKK (SEQ ID NO: 21), KKKRQKKQK (SEQ ID NO: 22),

KKRKKKKKRK (SEQ ID NO: 23), RRKKKKKK (SEQ ID NO: 24),

25   KKKKRRK (SEQ ID NO: 25), KKKKRRKK (SEQ ID NO: 26),

KKKKRKK (SEQ ID NO: 27), KKRKKKKK (SEQ ID NO: 28),

KKRKKHKKRK (SEQ ID NO: 29), RRKKKHKKK (SEQ ID NO: 30),

KKHKKRRK (SEQ ID NO: 31), KKHKKRRKK (SEQ ID NO: 32),

KKKHKRKK (SEQ ID NO: 33), RHKKHKKKR (SEQ ID NO: 34),

5   RKHKKKRKKK (SEQ ID NO: 35), HHKRKKKRK (SEQ ID NO: 36),

KKRHHKRK (SEQ ID NO: 37), KKHRKKH (SEQ ID NO: 38) and

KKKQKRK (SEQ ID NO: 39).

3.   The peptide according to claim 1 consisting of amino acids selected from histidine (H), lysine (K), glutamine (Q), and arginine

10   (R).

4.   An expression cassette comprising a DNA transgen encoding a fusion protein comprising a leader sequence, a protein of interest and the delivery peptide of claim 1.

5.   The expression cassette of claim 4 further comprising

15   expression control sequences operatively linked to said DNA.

6.   A transfer vector comprising the expression cassette of claim 4.

7.   A peptide-cargo complex comprising the delivery peptide of claim 1 and at least one cargo molecule.

20   8.   The peptide-cargo complex of claim 7, wherein the delivery peptide is selectively linked to the outer surface of at least one cargo molecule.

9.   The peptide-cargo complex of claim 8, wherein the linkage is formed by a cleavable linker.

10.   The peptide-cargo complex of claim 8, wherein the linkage includes a disulfide bond.

11.   The peptide-cargo complex of claim 8, wherein the linkage includes a streptavidin-biotin complex.

5   12.   The peptide-cargo complex of claim 7, wherein the delivery peptide is biotinylated and the cargo molecule is avidin labeled.

13.   The peptide-cargo complex of claim 7, wherein the cargo comprises at least one compound selected from the group consisting of polynucleotides, polypeptides, proteins, small organic molecules, 10   metals, viruses, modified viruses, viral vectors, and plasmides.

14.   The peptide-cargo complex of claim 7, wherein the cargo is a virus selected from the group consisting of adenoviruses, adeno-associated viruses, herpes viruses, simplex virus, and retroviruses.

15.   The peptide-cargo complex of claim 7, wherein the cargo is 15   selected from the group consisting of therapeutic proteins, suicide proteins, tumor suppressor proteins, transcription factors, kinase inhibitors, kinases, regulatory proteins, apoptotic proteins, anti-apoptotic proteins, viral antigens, cellular antigens, differentiation factors, immortalisation factors, toxines, enyzmes, nucleic acids, 20   antisense constructs, diagnostic imaging or contrast agents, dyes, antibacterial agents, antifungal agents, antiviral agents, antiproliferative agents, cytostatics, immunosuppressive agents, vitamins, analgesic agents, hormones, antiinflammatory agents, and antiaging agents.

16.   The peptide-cargo complex of claim 7, wherein the cargo is an antiviral agent selected from the group consisting of acyclovir, famciclovir, ganciclovir, foscarnet, idoxuridine, sorivudine, trifluridine (trifluoropyridine), valacyclovir, cidofovir, didanosine, stavudine,

5   zalcitabine, zidovudine, ribavirin and rimantatine.

17.   The peptide-cargo complex of claim 7, wherein the cargo is an antibacterial agent selected from the group consisting of nafcillin, oxacillin, penicillin, amoxacillin, ampicillin, cephalosporine, cefotaxime, ceftriaxone, rifampin, minocycline, ciprofloxacin,

10   norfloxacin, erythromycin, tetracycline, gentamicin, a macrolide, a quinolone, a β-lactone, a P-lactamase inhibitor, salicylamide, and vancomycin.

18.   The peptide-cargo complex of claim 7, wherein the cargo is an antifungal agent selected from the group consisting of amphotericin,

15   itraconazole, ketoconazole, miconazole, nystatin, clotrimazole, fluconazole, ciclopirox, econazole, naftifine, terbinafine and griseofulvin.

19.   The peptide-cargo complex of claim 7, wherein the cargo is an antineoplastic agent selected from the group consisting of

20   pentostatin, pentamidine, 6-mercaptopurine, 6-thioguanine, methotrexate, bleomycins, etoposide, teniposide, dactinomycin, daunorubicin, doxorubicin, mitoxantrone, hydroxyurea, 5-fluorouracil, cytarabine, fludarabine, mitomycin, cisplatin, procarbazine, dacarbazine, paclitaxel, colchicine, and vinca alkaloids.

25   20.   The peptide-cargo complex of claim 7, wherein the cargo is an immunosuppressive agent selected from the group consisting of

methotrexate, azathioprine, fluorouracil, hydroxyurea, 6-thioguanine, cyclophosphamide, mechloroethamine hydrochloride, carmustine, cyclosporine, taxol, tacrolimus, vinblastine, dapsone, nedocromil, cromolyn (cromoglycic acid), and sulfasalazine.

5   21.   The peptide-cargo complex of claim 7, wherein the cargo is an analgesic agent selected from the group consisting of lidocaine, bupivacaine, novocaine, procaine, tetracaine, benzocaine, cocaine, mepivacaine, etidocaine, proparacaine, ropivacaine, and prilocaine.

22.   The peptide-cargo complex of claim 7, wherein the cargo is a
10   hormone selected from the group consisting of tissue hormones, in particular prostaglandine, serotonine, histamine, bradykinin, kallikrein, and gastrointestinal hormones, releasing hormones, pituitary hormones, insulin, vasopressin (ADH), glucagon, enkephalin, calcitonin, and corticosteroides.

15   23.   The peptide-cargo complex of claim 7, wherein the cargo is a histamine receptor agonist or antagonist selected from 2-methylhistamine, 2-pyridylethylamine, 2-thiazolylethylamine, (R)-a-methylhistamine, impromidine, dimaprit, 4(5)methylhistamine, diphenhydramine, pyrilamine, promethazine, chlorpheniramine,
20   chlorcyclizine, and terfenadine.

24.   The peptide-cargo complex of claim 7, wherein the cargo is an cytokine or growth factor selected from the group consisting of IL-1Ra, STNF-R (p55), STNF-R (p75), SIL-1R type I, SIL-1R type II, BMP-2, BMP-6, BMP-7, LMP-1, LMP-3, IGF-1, TGF-ß1, TGF-ß2,
25   TGF-ß3, IL-4, IL-10, CTLA4, CD30, TIMP-1, IFN-ß, Sox-9, and PDGF.

25. The peptide-cargo complex of claim 7, wherein the cargo is an antiaging agent selected from the group consisting of retinoic acid, hyaluronic acid, collagen, and free radical catchers, in particular SOD.

5 26. The peptide-cargo complex of claim 7, wherein the cargo is a therapeutic agent for a condition selected from the group consisting of Crohn's disease, ulcerative colitis, gastrointestinal ulcers, peptic ulcer disease, and abnormal proliferative diseases.

27. The peptide-cargo complex of claim 7, wherein the cargo is a
10 therapeutic for ulcers and is selected from the group consisting of an H2-histamine inhibitor, an inhibitor of the proton-potassium ATPase, and an antibiotic directed at *Helicobacter pylori*.

28. The peptide-cargo complex of claim 7, wherein the cargo is a therapeutic agent for treating a bronchial condition selected from
15 cystic fibrosis, asthma, allergic rhinitis, and chronic obstructive pulmonary disease.

29. The peptide-cargo complex of claim 7, wherein the cargo is a therapeutic agent for treating ischemia, Parkinson's disease, schizophrenia, cancer, acquired immune deficiency syndrome
20 (AIDS), infections of the central nervous system, epilepsy, multiple sclerosis, neurodegenerative disease, trauma, depression, Alzheimer's disease, migraine, pain, and a seizure disorder.

30. The peptide-cargo complex of claim 7, wherein the cargo is a therapeutic agent for a condition selected from the group consisting
25 of inflammatory and degenerative joint and spine diseases, arthritis,

especially osteoarthritis, low back pain, bone repair, fracture healing, therapy of muscle and ligament injury.

31.   Use of the peptide according to claim 1 for cellular internalisation of a cargo molecule linked thereto.

5   32.   Use of the peptide according to claim 1 for the production of a kit for cellular internalisation of a cargo molecule linked thereto in an animal or a human body.

33.   Use of the peptide according to claim 1 for nuclear translocation in a target cell.

10   34.   Use of the peptide according to claim 1 for the production of a kit for nuclear translocation in a target cell in an animal or a human body.

35.   Use of the peptide according to claim 1 for translocation in the mitochondria of a target cell.

15   36.   Use of the peptide according to claim 1 for the production of a kit for translocation in the mitochondria of a target cell in an animal or a human body.

37.   Use of the peptide according to claim 1 for the treatment of Crohn's disease, ulcerative colitis, gastrointestinal ulcers, peptic

20   ulcer disease, abnormal proliferative diseases, an infection with *Helicobacter pylori*, cystic fibrosis, asthma, allergic rhinitis, chronic obstructive pulmonary disease, ischemia, Parkinson's disease, schizophrenia, cancer, acquired immune deficiency syndrome (AIDS), infections of the central nervous system, epilepsy, multiple

sclerosis, neurodegenerative disease, trauma, depression, Alzheimer's disease, migraine, pain, and a seizure disorder.

38.   Use of the peptide according to claim 1 for the production of a composition for the treatment of Crohn's disease, ulcerative colitis,

5   gastrointestinal ulcers, peptic ulcer disease, abnormal proliferative diseases, an infection with *Helicobacter pylori*, cystic fibrosis, asthma, allergic rhinitis, chronic obstructive pulmonary disease, ischemia, Parkinson's disease, schizophrenia, cancer, acquired immune deficiency syndrome (AIDS), infections of the central

10   nervous system, epilepsy, multiple sclerosis, neurodegenerative disease, trauma, depression, Alzheimer's disease, migraine, pain, and a seizure disorder in an animal or a human body.

39.   Use of the peptide according to claim 1 for the treatment of glucocerebrosidase deficiency (Gaucher's disease),

15   mucopolysaccharidosis I, sanfilippo B syndrome, pancreatic insufficiency, severe combined immunodeficiency syndrome, and neuromuscular dysfunction associated with triose phosphate isomerase deficiency.

40.   Use of the peptide according to claim 1 for the production of a

20   composition for the treatment of glucocerebrosidase deficiency (Gaucher's disease), mucopolysaccharidosis I, sanfilippo B syndrome, pancreatic insufficiency, severe combined immunodeficiency syndrome, and neuromuscular dysfunction associated with triose phosphate isomerase deficiency in an animal

25   or a human body.

41.   Use of the peptide according to claim 1 for the treatment of inflammatory and degenerative joint and spine diseases, arthritis, especially osteoarthritis, low back pain, bone repair, fracture healing, therapy of muscle and ligament injury.

5   42.   Use of the peptide according to claim 1 for the production of a composition for the treatment of inflammatory and degenerative joint and spine diseases, arthritis, especially osteoarthritis, low back pain bone repair, fracture healing, therapy of muscle and ligament injury in an animal or a human body.

10   43.   A pharmaceutical composition comprising:

a cargo-peptide complex according to claim 7, comprising an effective amount of a biologically active or therapeutic agent, and

a pharmaceutically acceptable carrier.

15   44.   A method for the delivery of a cargo to the surface of, into or across a biological barrier, comprising:

a)   providing a cargo and at least one delivery peptide according to claim 1,

b)   forming a peptide-cargo complex,

20   c)   contacting the barrier with the peptide-cargo complex, and

d)   delivering the cargo to the surface of, into or across the barrier.

45.   The method of claim 44, wherein the barrier is an intact epithelial or endothelial tissue layer or layers.

46.   The method of claim 44, wherein the barrier is skin.

47.   The method of claim 46, wherein the cargo is delivered into and/or across one or more of the layers stratum corneum, stratum granulosum, stratum lucidum, and stratum germinativum.

5   48.   The method of claim 46, wherein the contacting of the skin with the peptide-cargo complex is accomplished by administering a composition comprising the peptide-cargo complex topically to the skin, and in particular the cargo is taken up by cells that comprise the follicular or interfollicular epidermis.

10   49.   The method of claim 48, with the composition being a cream, ointment, salve, lotion, or a transdermal patch.

50.   The method of claim 44, wherein the barrier is the gastrointestinal tract.

51.   The method of claim 44, wherein the barrier is the pulmonary
15   epithelium.

52.   The method of claim 44, wherein the barrier is the endothelial blood brain barrier.

53.   A method for inducing synovial cell death comprising administering the peptide-cargo complex of claim 7 to said synovial
20   cell.

54.   Use of the peptide-cargo complex of claim 7 for the production of a composition for inducing synovial cell death in an animal or a human body.

55.   A method for inducing apoptosis in a tumor cell comprising administering the peptide-cargo complex of claim 7, in particular comprising an apoptotic protein, to said tumor cell.

56.   Use of the peptide-cargo complex of claim 7, in particular comprising an apoptotic protein, for the production of a composition for inducing apoptosis in a tumor cell in an animal or a human body.

57.   A method for reducing white blood cells in arthritic joints comprising administering the peptide-cargo complex of claim 7 to said white blood cells.

58.   Use of the peptide-cargo complex of claim 7 for the production of a composition for reducing white blood cells in arthritic joints in an animal or a human body.

59.   A method for reducing the effects of skin aging comprising administering the peptide-cargo complex of claim 7, in particular comprising an antiaging agent, to the skin.

60.   Use of the peptide-cargo complex of claim 7, in particular comprising an antiaging agent, for the production of a composition for reducing the effects of skin aging in an animal or a human body.

61.   Use according to claim 60, with the composition forming a cream, ointment, salve, or lotion.

62.   A method for eliciting an immune response in an animal or a human body comprising administering to a target cell of said body an immunogen comprising the peptide-cargo complex of claim 7.

63.   Use of the peptide-cargo complex of claim 7, for the production of a immunogen for eliciting an immune response in an animal or a human body.